



Friction & Gravity

Every day forces

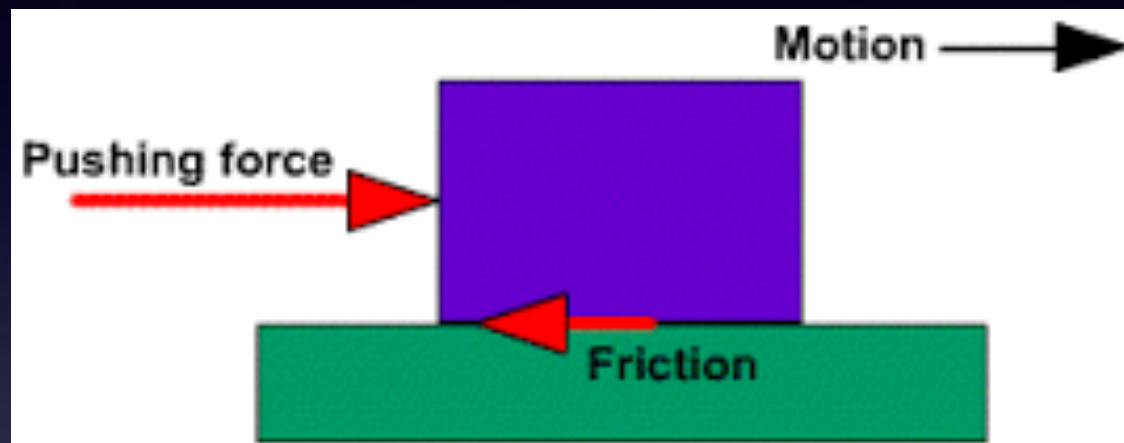
Friction

When a sled moves across snow, the bottom of the sled rubs against the surface of the snow. In the same way, the skin of a firefighter's hands rubs against the polished metal pole during the slide down the pole.

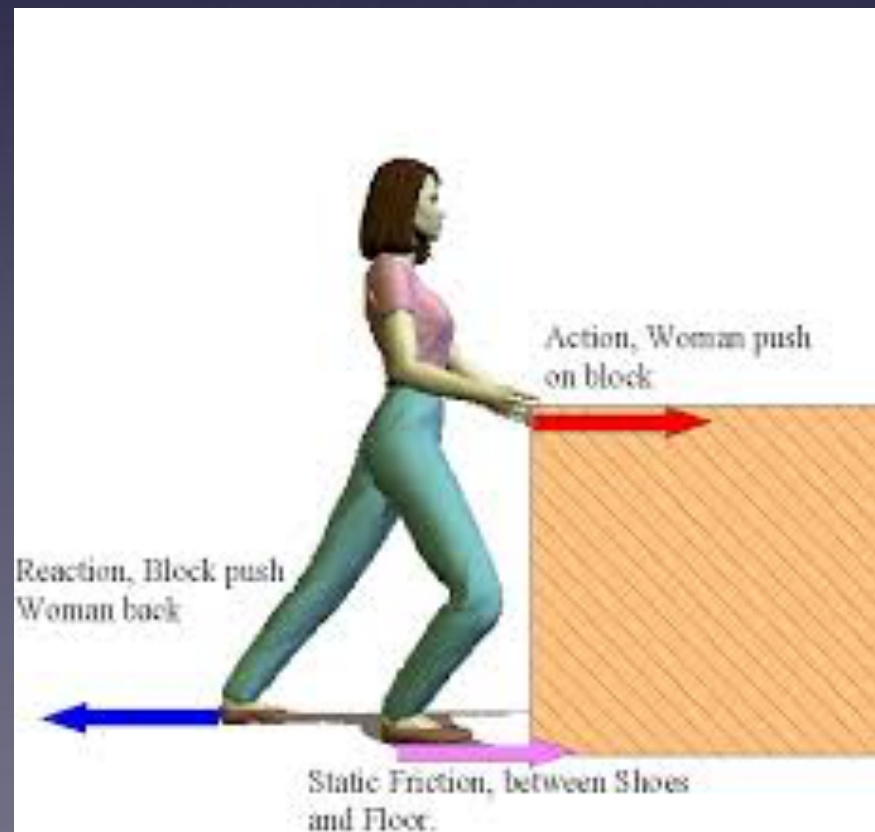
The force that two surfaces exert on each other when they rub against each other is called **friction**.



The Causes of Friction

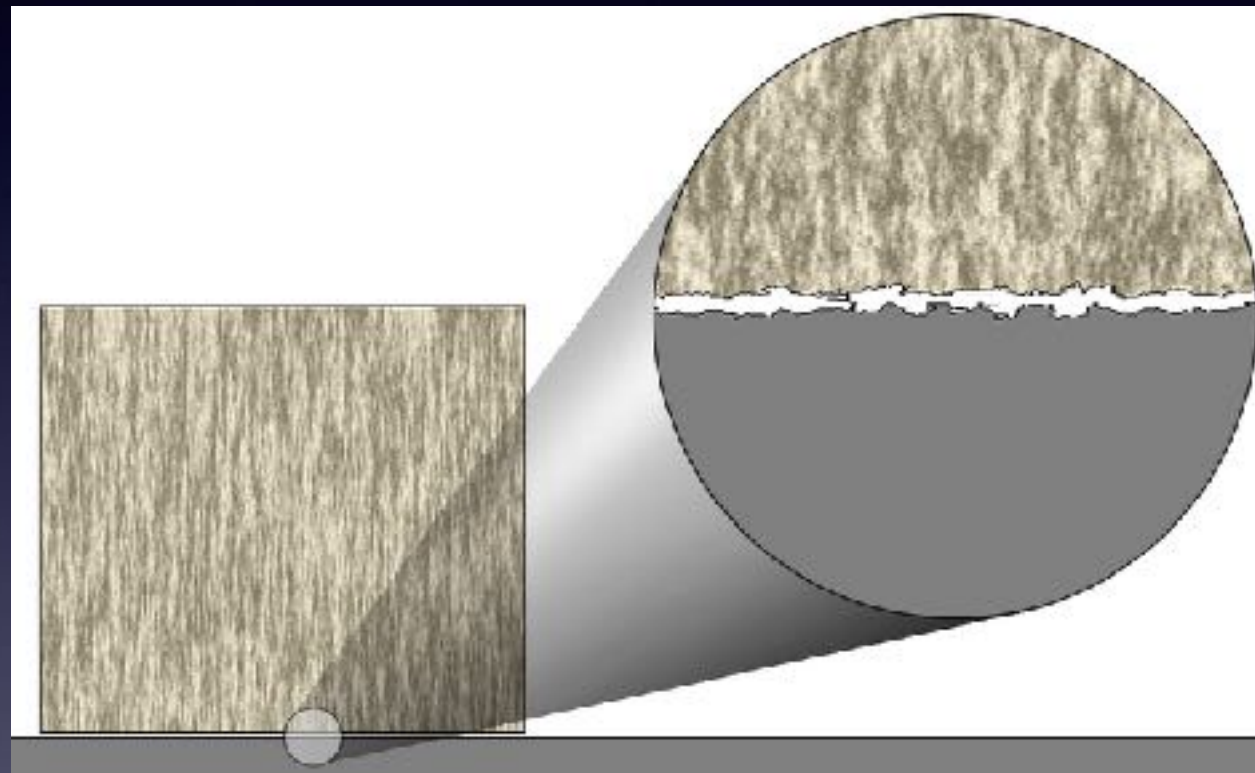


Friction acts in a direction opposite to the direction of the moving object. Friction will eventually cause an object to come to a stop.



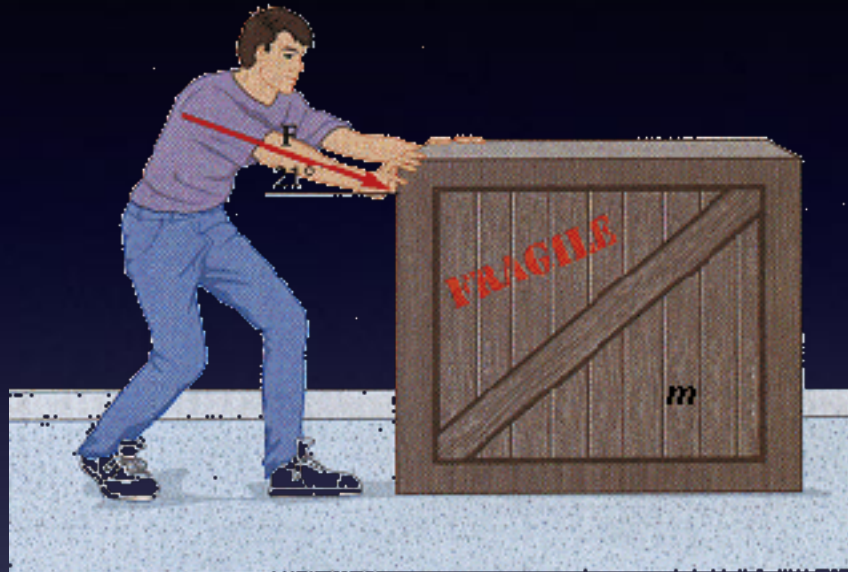
The strength of the friction force depends on two factors: how hard the surfaces push together and the types of surfaces involved.

Skiers get a fast ride because there is very little friction between their skis and the snow. Rough surfaces produce greater friction than smooth surfaces. Friction also increases if the surfaces push hard against each other.



Even the smoothest objects have irregular, bumpy surfaces. When the irregularities of one surface come into contact with those of another surface, friction occurs. Friction acts in a direction opposite to the direction of the object's motion. Without friction, a moving object might not stop until it strikes another object.

Types of Friction



Static Friction

Static friction acts on objects that aren't moving. Because of static friction, you must use extra force to start the motion of stationary objects.



Sliding Friction

Sliding friction occurs when solid surfaces slide over each other. When you stop a bicycle with hand brakes, the rubber pads slide against the tire surfaces, causing the wheels to slow and eventually stop.

Rolling Friction

Rolling friction occurs when an object rolls over a surface.

Rolling friction is easier to overcome than sliding friction for similar materials.

This type of friction is important to engineers who design certain products, such as skateboards or skates need wheels to move freely.

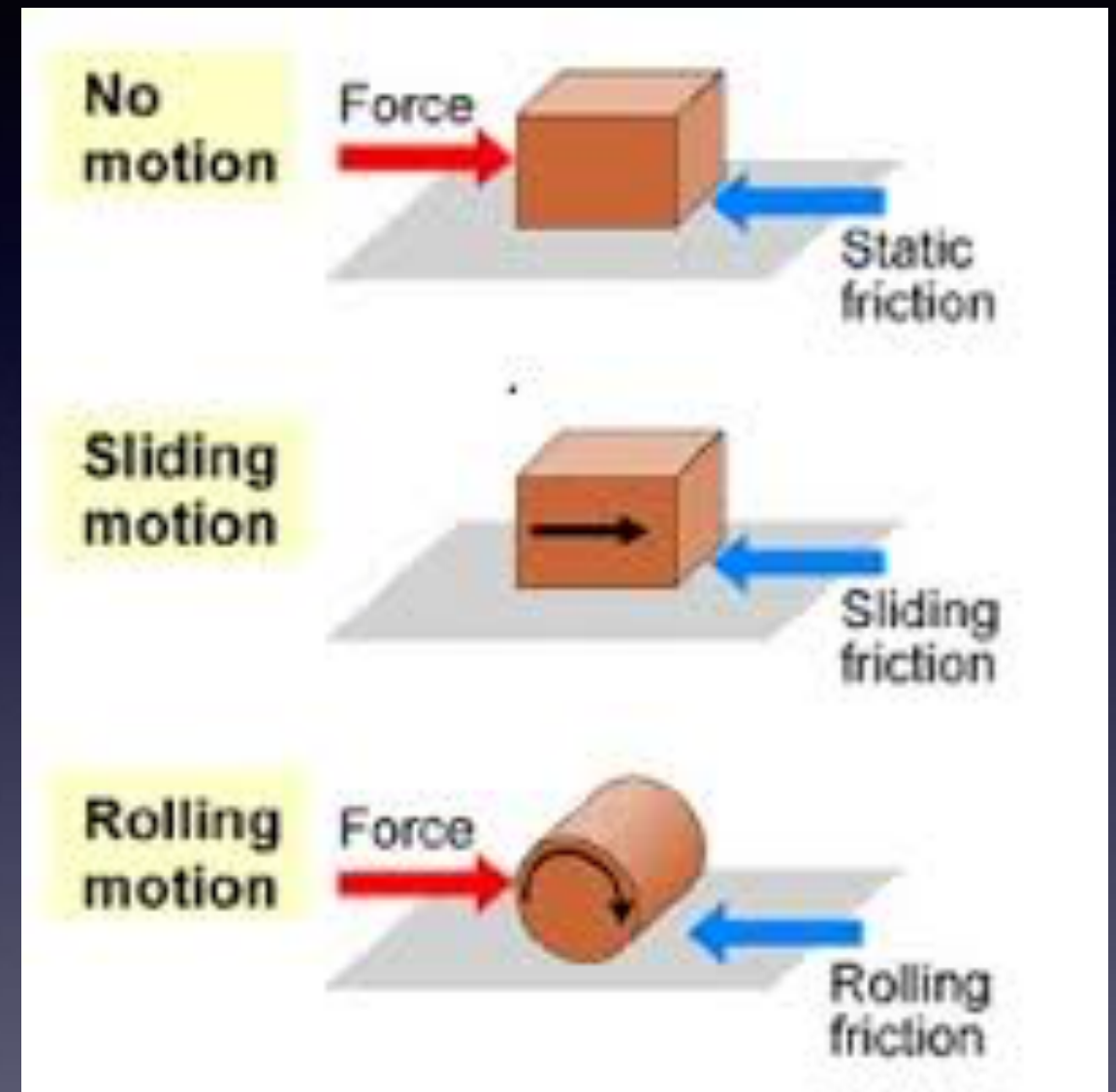
Engineers use ball bearings to reduce the friction between the wheels and the rest of the product.



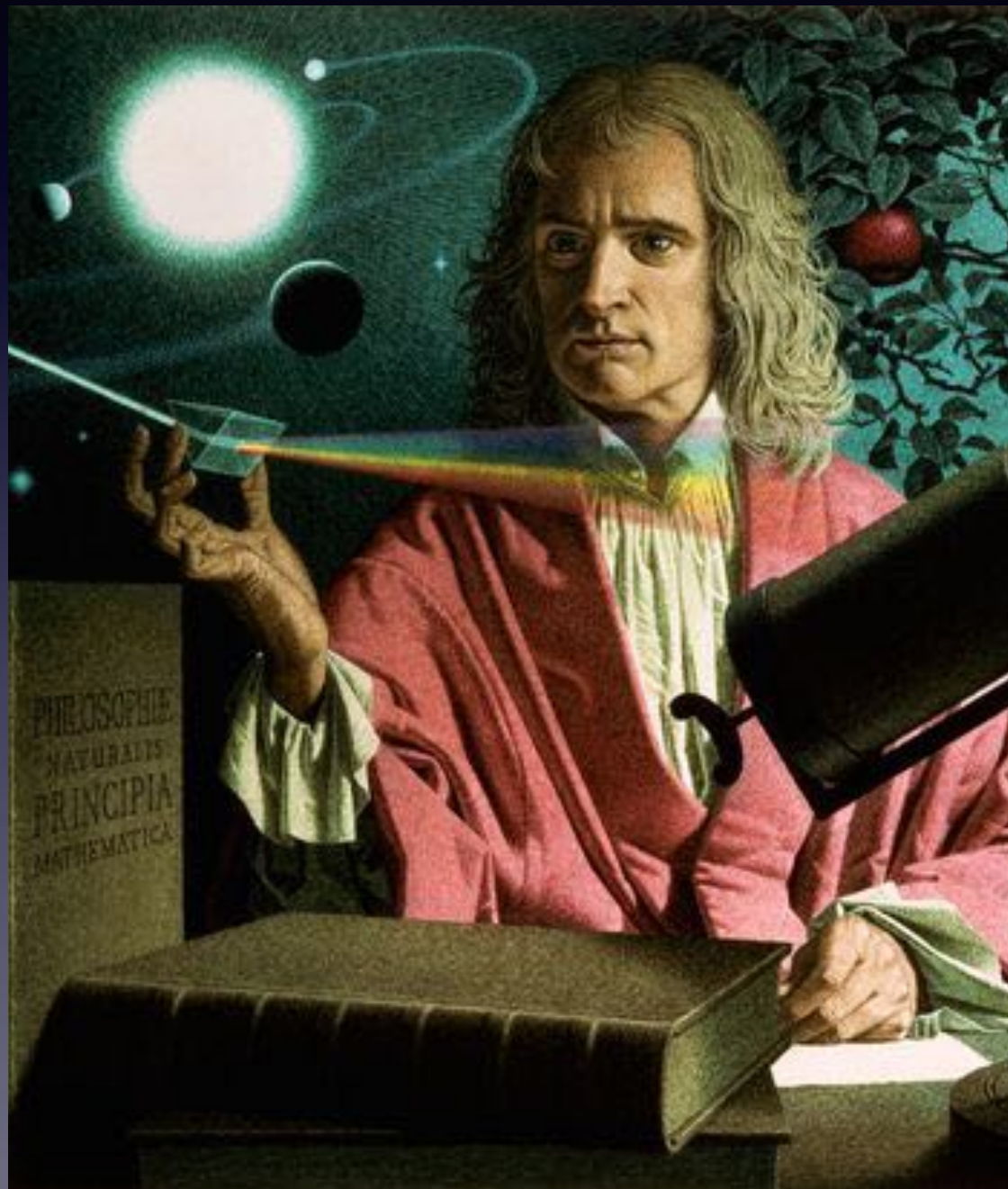
Fluid Friction

Fluid friction results when an object moves through a fluid – liquid or gas – such as water, oil, or air. Like rolling friction, fluid friction is easier to overcome than sliding friction.

This is why parts of a machine that must slide over each other are bathed in oil. In this way, the solid parts move through the fluid instead of sliding against each other.



Gravity



Isaac Newton thought about why things fall. He concluded that a force acts to pull objects straight down toward the center of the Earth.

Gravity is the force that pulls objects toward each other.

Universal Gravitation

Newton realized that gravity acts everywhere in the universe, not just on Earth. It is the force that makes an apple fall to the ground, and is the force that keeps the moon orbiting around Earth.



The **law of universal gravitation** states that the force of gravity acts between all objects in the universe. Any two objects in the universe, without exception, attract each other.



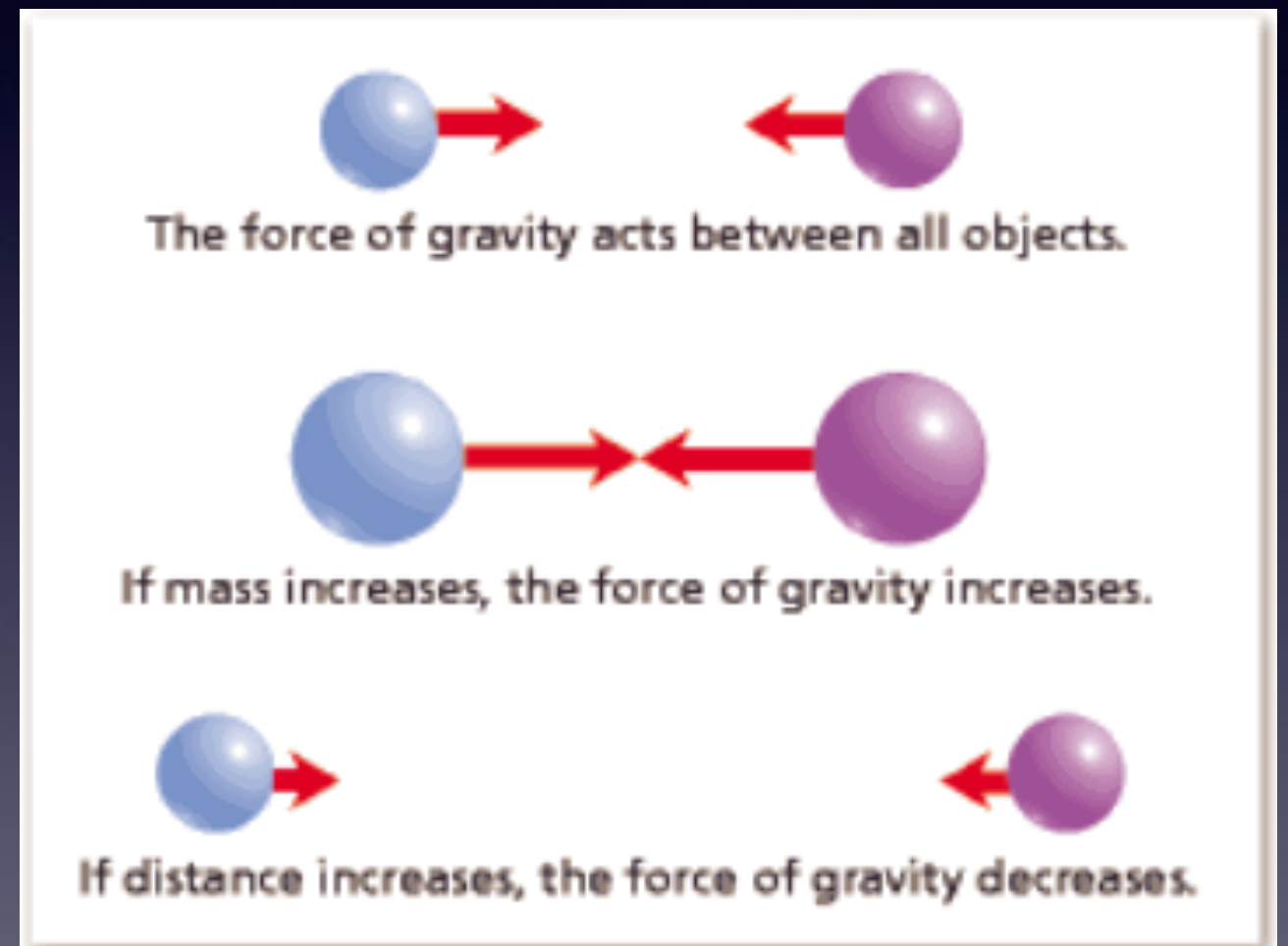


You are attracted to Earth and the objects around you. You don't notice the attraction among other objects because these forces are too small compared to the force of the Earth's attraction.

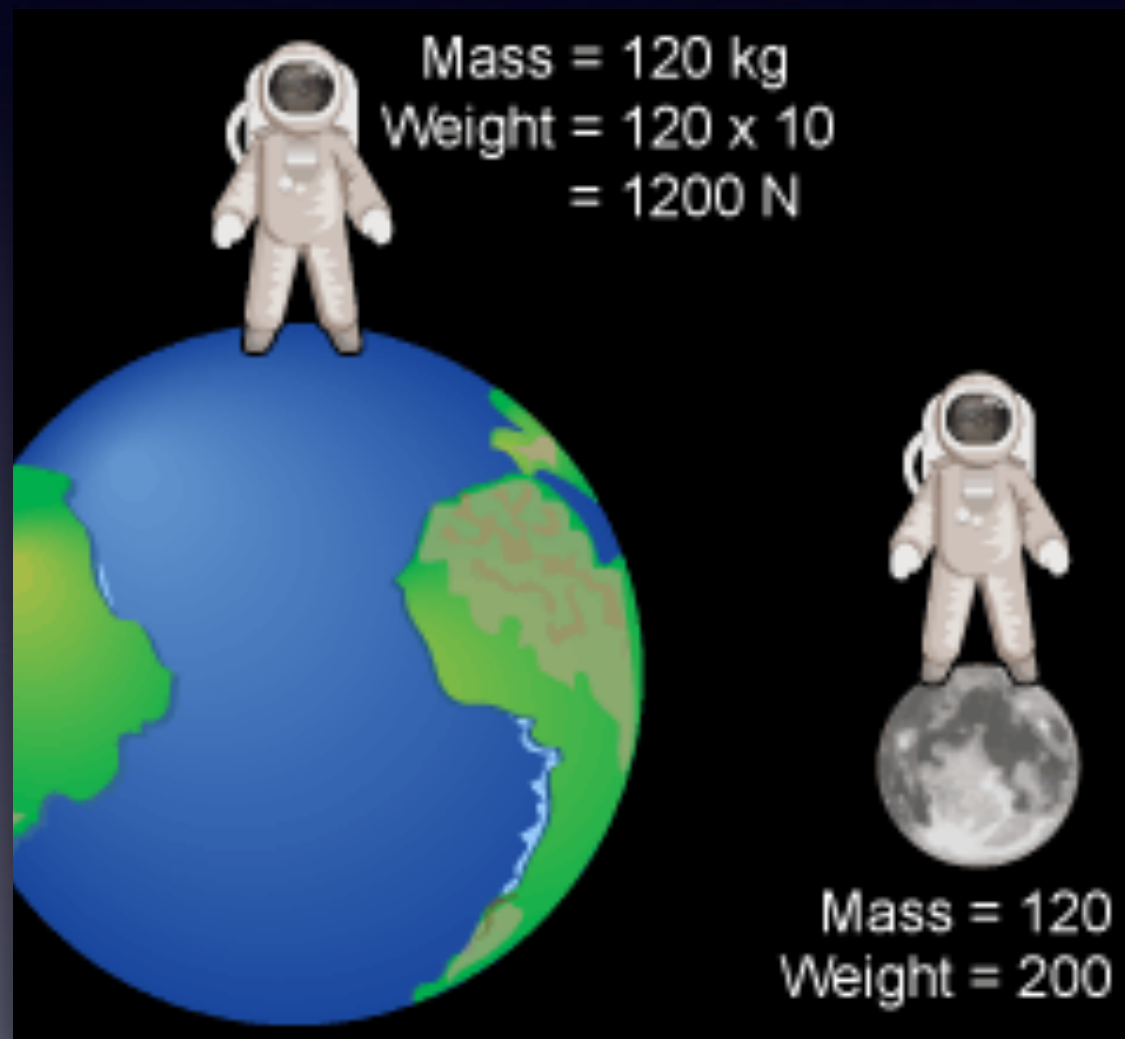
Factors Affecting Gravity

Two factors affect gravitational attraction between objects: mass and distance. Mass is a measure of the amount of matter in an object.

The more mass an object has, the greater its gravitational force. The farther apart two objects are, the less gravitational force between them.



Mass & Weight



Weight is the force of gravity on a person or object at the surface of a planet. Weight is a measure of the force of gravity on an object, and mass is a measure of the amount of matter in that object

Weight varies with the strength of the gravitational force but mass does not.

Free Fall

When the only force acting on a falling object is gravity, the object is in **free fall**. In free fall, the force of gravity is an unbalanced force that causes an object to accelerate.

Near Earth's surface, acceleration due to gravity is 9.8m/s^2 . This means that for every second an object is falling, its velocity increases by 9.8m/s .

All objects in free fall accelerate at the same rate regardless of their masses.



Air Resistance



Even though objects are supposed to fall at the same rate, you know that this is not always the case. For example, an oak leaf flutters slowly to the ground, while an acorn drops straight down.

Objects falling through air experience a type of fluid friction called **air resistance**. Remember that friction is in the direction opposite to motion, so air resistance is an upward force exerted on falling objects.



Air resistance is not the same for all objects. The greater the surface area of an object, the greater the air resistance. That is why a leaf falls more slowly than an acorn.



Air resistance also increases with velocity. So, as the velocity of a falling object increases, air resistance increases until it is equal to the force of gravity.

When forces are balanced, the velocity stops increasing. The object continues to fall, but its velocity remains constant.

The greatest velocity that can be obtained by an object in free fall is called **terminal velocity**.

Terminal velocity is reached when the force of air resistance equals the weight of the object.



Projectile Motion



An object that is thrown is called a **projectile**. When you throw a projectile, it will land on the ground at the same time as an object that is dropped.

When you throw a projectile at an upward angle, the force of gravity reduces its vertical velocity. Eventually, the upward motion of the projectile will stop, and gravity will pull it back toward the ground.

While a projectile moves horizontally, the force of gravity pulls it toward Earth. From this point, the projectile will fall at the same rate as any dropped object.

Keywords: English - Spanish

Law of Universal Gravitation - Ley de la Gravitación Universal

Static Friction - Fricción estática

Weight - Peso

Sliding Friction - Fricción de deslizamiento

Friction - Fricción

Rolling Friction - Fricción de rodadura

Gravity - Gravedad

Fluid Friction - La fricción de fluidos

Terminal Velocity - Velocidad terminal

Projectile - Proyectoile

Air Resistance - Resistencia del aire